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AVOIDANCE RESPONDING IN PIGEONS[1]

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Four pigeons were trained in a one-way shuttle box avoidance situation. Three of the birds met the criterion of 90% avoidances; the fourth, although frequently avoiding successfully, was too erratic to meet the criterion. Avoidance responding in two of the birds was subsequently extinguished, showing that the response was true avoidance, and not escape from the buzzer warning stimulus. In Experiment 2, the three birds that had met criterion in Experiment 1 were trained in a two-way avoidance task, and all three met the criterion of 90% avoidances. The shuttle box therefore provides a rapid and reliable method of obtaining avoidance performance in pigeons.

Although shock-motivation has been used successfully in pigeons to punish behavior (Azrin, 1959*a*) and to obtain conditioned suppression (Hoffman, 1965), efforts to train pigeons to escape or avoid shock have met with considerable difficulty. Hoffman and Fleshler (1959), using head-lifting as the response to be conditioned, established avoidance responding in one bird, but this animal required more than 3000 tone-shock pairings to achieve 50% avoidance responses and was still responding at below the 80% level when, after more than 3500 pairings, their experiment terminated. Rachlin and Hineline (1967) suggested that this problem might be due to two factors: that the sensitivity of individual birds to shock of fixed intensity varies, and that only a narrow band of intensities is effective, as an extreme instance of the Yerkes-Dodson law (Yerkes and Dodson, 1908). Rachlin and Hineline demonstrated that pigeons could be trained to escape a train of shocks of gradually increasing intensity, but they did not report any attempts to train their birds to avoid.

It is clearly important for those interested in the comparative study of learning to know whether pigeons are incapable of efficient avoidance learning; if so, they differ significantly from rats. The resolution of this question is also of interest to workers on the comparative physiology of learning, due to the increasing use of avoidance tests in the analysis of mammalian brain lesions.

EXPERIMENT 1

This experiment studied the behavior of pigeons in a one-way shuttle box avoidance task.

METHOD

Subjects

Four adult farm-caught pigeons (*Columba livia*) were kept in individual cages, and given free access to food and water throughout the experiment. Each bird had a pair of stainless steel electrodes implanted under the pubis bones and attached to a harness (Azrin, 1959*b*). The resistance of the electrodes *in situ* was approximately 20 K in all cases.

Apparatus

The experiment was conducted in a quiet light-proof room, which could be illuminated by three 60-w lights in the ceiling. The apparatus was a wooden box, 28 in. long, 10 in. deep, and 12 in. high, divided into two compartments, one black, one white. The front wall was of Perspex gauze, for observation purposes. A retractable wooden door ran between two 1-in.-high wooden runners fitted to the floor. The pre-shock stimulus complex consisted of three simultaneous events: (a) illumination of a naked 1-w bulb in the roof of the black compartment, (b) onset of a buzzer warning stimulus in the roof of the box, and

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(c) withdrawal of the door. The shock was taken from a 275-v 50-cps ac transformer, through a bank of resistors calibrated to deliver from 0.5 to 5 ma in 0.5-ma steps; shock was delivered by leads running in a 1-in. wide slit in the roof of the box.

Procedure

At the beginning of each trial, the bird was placed in the black compartment, with the room lights on. After a 5-sec delay, all lights were off for 5 sec, after which the pre-shock stimulus complex was presented. If the bird placed both feet on the floor of the white compartment within 7.5 sec of the buzzer onset, shock was not presented, and the buzzer was terminated. If the bird failed to cross over within 7.5 sec of buzzer onset, continuous shock was delivered until it entered the white compartment, when both buzzer and shock were terminated. Following escape or avoidance, the door was replaced, and a green 1-w bulb in the roof of the white compartment was illuminated for 15 sec. The room lights were then illuminated, and the green light extinguished; after 30 sec, the bird was replaced in the black compartment and a new trial began.

Shock intensity was 0.5 ma for the first trial, and was raised every four trials in 0.5-ma steps until the bird escaped within 20 sec of shock onset. The intensity at which this first occurred was used for all future trials for the bird; buzzer and shock were both terminated after 20 sec if no escape occurred.

Birds were tested 20 trials a day, and were trained to a criterion of 36 avoidances out of the 40 trials of two successive days. Two birds were then given extinction training, in which conditions were identical except that no shock was presented. The buzzer persisted until the bird entered the white compartment, or for a maximum of 20 sec. The extinction procedure was maintained until the bird had failed to cross into the white compartment within 7.5 sec of buzzer onset on 36 of the 40 trials of two successive days.

Results and Discussion

Escape performance was invariably rapid within a few trials of the first successful escape; intensities used were 1.5 ma (Birds 4 and 6), 2 ma (Bird 3), and 2.5 ma (Bird 5).

The course of avoidance learning is presented in Fig. 1, which shows that three birds learned to the 90% criterion within 120 trials; training of the fourth bird was abandoned after 200 trials, at which stage its performance was still most erratic.

Extinction trials were given to ensure that birds were not simply escaping the buzzer, which might have been aversive, rather than avoiding shock; the successful extinction performances show that true avoidance had been established.

It is therefore clear that avoidance behavior motivated by a shock of constant intensity can be established in pigeons, using running as the conditioned response. It is assumed that the difficulty in establishing key-pecking as an avoidance response is related to the very low likelihood of its occurrence during shock, although this does not entirely explain Hoffman and Fleshler's (1959) difficulty in obtaining avoidance using head-raising (which does sometimes occur during shock) as the response to be conditioned.

EXPERIMENT 2

This experiment was designed to see whether pigeons would learn to shuttle to avoid shock. This further study is important because it is known that some brain lesions in mammals affect one-way and two-way avoidance differentially (Lubar and Perachio, 1965).

Method

Subjects

The three birds that had previously met the criterion of learning in Exp. 1 were used.

Apparatus

The shuttle-box was constructed in the same way as the box used in Exp. 1, except that both compartments were painted gray, and each contained a 1-w amber light in the roof.

The pre-shock stimulus complex consisted of three simultaneous events: (a) illumination of the bulb in the compartment in which the bird stood, (b) sounding of the buzzer, and (c) withdrawal of the door. Shock techniques and intensities used were those established in Exp. 1.

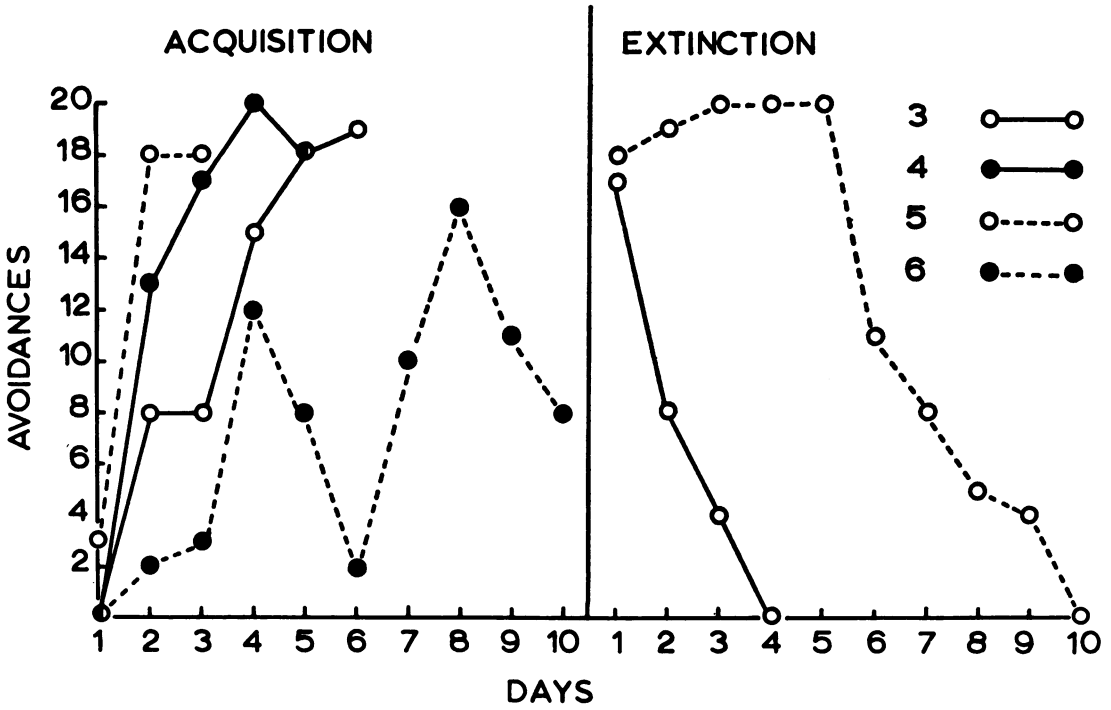

Fig. 1. Individual learning curves for subjects in Exp. 1.

Procedure

Each trial began with presentation of the pre-shock stimulus complex. If the bird crossed into the other compartment within 7.5 sec of buzzer onset, shock was not presented, and the buzzer was terminated. If the bird failed to cross over within 7.5 sec of buzzer onset, continuous shock was delivered until it entered the other compartment, when both buzzer and shock were terminated. Following escape or avoidance, the door was replaced, and the amber bulb in the roof of the compartment now occupied was illuminated for 15 sec. All illumination was then extinguished for 40 sec, after which a new trial began; the room lights were not illuminated at any stage in this experiment.

Birds were tested 20 trials a day, and were trained to a criterion of 36 avoidances out of the 40 trials of two successive days.

Results and Discussion

The results of this experiment are summarized in Fig. 2, which shows that all three birds met the 90% criterion. The performance of Bird 4, which had not (in contrast to Birds 3 and 5) been extinguished in Exp. 1, suggests that there may have been some negative transfer from that situation.

Bird 5 learned very rapidly in this situation, as it had in the one-way avoidance task, and it is clear, from both its good performance, and the poor performance of Bird 6 in Exp. 1, that there are marked individual differences between pigeons in avoidance learning.

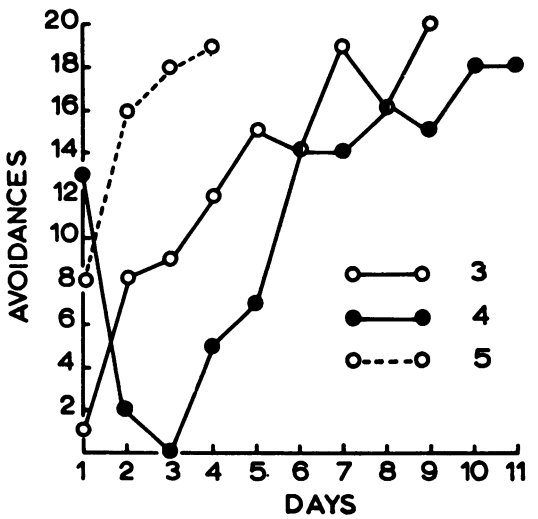

Fig. 2. Individual learning curves for subjects in Exp. 2.

Two qualifications concerning the nature of the performances of the birds in these experiments should be made: first, although the extinction procedure employed in Exp. 1 showed that the buzzer was not inherently aversive, there remains the possibility that it became aversive by pseudo-conditioning (which would have been extinguished by the subsequent procedure); second, since there was no control over the early experience of these birds, running may have been established as an escape or avoidance response to some more natural stimulus in the period before their capture.

It is regrettable that it has not so far proved possible to obtain avoidance responding from pigeons in a standard key-pecking apparatus, which lends itself so well to data collection; however, the apparatus used in these experiments is easy to construct, and could be automated without difficulty. Further behavioral studies using these techniques should help to identify the critical variables in the birds' performance, and perhaps throw more light on the problem of obtaining key-pecking as an avoidance response.

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